Macroeconomic determinants of long-term stock market comovements among major EMS countries

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Long-term comovements of national stock markets in three EMS (European Monetary System) countries–France, Germany and Italy–are examined. The EMS stock markets are found to display long-term comovements governed by two common permanent components. To identify some interpretable sources of such long-term market comovements, the study explores whether they can be linked to similar comovements in macroeconomic variables, including the money supply, dividends and industrial production. Like stock prices, two common permanent components are found driving the comovements in each of these variables. Further analysis suggests that the long-term comovements in stock prices can be partly attributable to those in the macroeconomic variables, especially for the post-1987 period. The results confirm at least a limited role of these macroeconomic variables in accounting for the stock market comovements among the EMS countries.

I. INTRODUCTION

Many studies have been devoted to investigating the empirical relationship between national stock markets, for which findings of comovements are sometimes interpreted as a loose form of international capital market integration. Early studies by Agmon (1972), Hillairet (1979), Levy and Sarnat (1970), Panton, et al. (1976), and Ripley (1973) mostly found little covariation in national stock price indexes based on data from the 1960s and 1970s. Motivated by the trend towards internationalization of equity markets, recent studies (Eun and Shim, 1989; Hamao et al., 1990; Koch and Koch, 1991; Schollhammer and Sand, 1987; Von Furstenberg and Jean, 1989) examine dynamic linkages among stock markets in the 1980s. These studies consistently find significant short-term comovements of national stock indexes, and the findings may be attributed to the growing importance of international investors and the substantial improvements in telecommunications and computer technology in the 1980s.

This study explores the potential existence and sources of long-term comovements of stock markets among three major member countries of the European Monetary System (EMS), namely, France, Germany and Italy. The aforementioned studies focus exclusively on short-term market comovements and examine how stock markets in the same or different time zones are linked and transmit information in the short run. Long-term comovements between national stock markets can also exist, however (Lai et al., 1993). Ripley (1973) observes that relative movements in stock indexes can reflect general changes in national income across countries. It follows that the presence of strong economic ties and policy coordination among the relevant countries can indirectly link their stock prices over time. Through international capital flows, moreover, real interest rates of some countries tend to move together over time. To the extent that stock prices are affected by interest rate movements, such interest rate linkage may contribute to long-term market comovements.

The EMS provides an interesting economic arrangement for studying comovements of financial markets, not just for their geographical proximity. Established in mid-March 1979 with exchange rate stabilization as a major goal, the EMS yields a hybrid system of pegged and adjustable
permits a decomposition of the dynamics of a multivariate system into permanent and transitory components and allows for long-term comovement analysis between sub-systems under a cointegration framework. For a system or subsystem of variables, its long-run behaviour is governed by a relatively small set of common permanent components. These permanent components represent the underlying forces driving long-term comovements among the variables. By obtaining common permanent components in different sub-systems of variables, researchers can analyse whether there are long-term comovements within individual variable groups and whether the comovements of a specific group of variables can be linked to those of others. In this study, we investigate the potential linkage between the common permanent components in four groups of variables, those of stock prices, the money supply, dividends, and industrial production of three EMS countries.

Several studies, including King et al. (1994), King and Wachwani (1990), and Hamiie et al. (1990), have examined transmission of volatility between national stock markets. These studies analyse short-term comovements in conditional variances of stock market returns across countries. King et al. (1994), specifically, report that only a small proportion of the short-term market covariances can be explained by observable economic variables. In the present study, long-term comovements between levels of stock market indices are examined, instead. The analysis abstracts from short-term market dynamics and focuses on permanent components of stock prices. Permanent and transitory components in stock prices may show different properties, with the former having much higher predictability than the latter (Fama and French, 1988; Foterba and Summers, 1988).

The paper is organized as follows. Section II briefly discusses the empirical methodology. Section III describes the data. Section IV contains empirical results. Section V provides further results of subperiod analysis. Section VI concludes.

II. STATISTICAL/METHODOLOGY

Gonzalo and Granger's (1995) analysis provides a decomposition of the dynamics of multivariate time series into permanent and transitory components, different from those obtained from others, e.g., Kasa (1995) and Stock and Watson (1988). The permanent component obtained from Gonzalo and Granger's method can be explicitly expressed as a function of observable variables (see Escribano and Peña (1996) for a discussion on the relationship between alternative common trend representations). Let \( X_t = \mu + \omega_t \) be a vector of \( n \) time series modelled by

\[
C(X_t) = \mu + \omega_t
\]
III. THE DATA

All stock price data series consist of the monthly Morgan Stanley Capital International (MSCI) market indexes, covering the period from April 1979 to June 1992 (Italy pulled out of the EMS in September 1992). The MSCI indexes are fully comparable across countries since they are constructed on a consistent basis. These indexes are value-weighted, computed with dividend reinvested, and expressed in terms of the US dollar. In constructing the MSCI indexes, the market value of investment companies and of foreign domiciled companies are excluded in order to double-counting. All stock indexes are converted into real dollars based on the US consumer price index. Data descriptions are contained in a joint report of the Morgan Stanley Capital International Perspectives.

The multivariate data under study include monthly money supply (M1) and industrial production series taken from the OECD's Main Economic Indicators data bank. These series are converted into real US dollars using relevant spot exchange rates and consumer price indexes. Monthly spot exchange rates are drawn from the IMF's International Financial Statistics data tape; consumer price indexes are obtained from the OECD's Main Economic Indicators data bank. The real dividend data are extracted from the difference between series of dividend-indexed and dividend-exclusive MSCI indexes (adjusted for rights issues, stock dividends, and stock splits). These dividend series represent the gross dividends an investor would receive if the investor were investing in the portfolios defined by the MSCI stock price indexes.

As a preliminary analysis, each series is first checked for a unit root using the augmented Dickey-Fuller (ADF) test that allows for a linear trend. The null hypothesis is that the variable series has a unit root. The test is conducted on the levels and first differences of the logarithm series of the stock price index, the money supply, dividends, and industrial production for each of the three EMS countries. The test results are reported in Table I. In no case can the unit root hypothesis be rejected at any standard significance level for level series; whereas, tests performed on first differences strongly indicate that the first of the first-differenced series is stationary. The evidence supports that all the level series contain a single unit root. Figures 1(a) to 1(d) contain plots of the data series under examination. Although individual series across countries can wander extensively, they appear to move in close association over time.

IV. EMPIRICAL RESULTS

Long-term comovements among stock markets are first analysed. The empirical analysis focuses mainly on three national stock markets in France (FR), Germany (GM) and Italy (IT), though some evidence on comovements for
non-EMS stock markets in Canada, Japan, the UK and the US will also be reported.

**Common permanent components in stock prices**

For the lag specification in cointegration analysis, the lag order $k$ was first estimated using a model selection procedure based on the Schwartz information criterion. The maximum lag length considered was $k = 8$. The corresponding residuals were tested for serial correlation using the Ljung-Box test. If the residuals could not pass the serial correlation test, the lag length would be increased until the serial correlation was removed statistically. In the case for stock prices, $k = 2$ is selected. Residual diagnostic statistics (not reported) were also computed, and they supported the adequacy of the lag specification.

The cointegration test statistics, $\lambda_{\text{max}}$ and $\lambda_{\text{max}}$, are provided in Table 2, along with their corresponding finite sample critical values. The use of proper finite sample critical values is particularly important for out-of-sample tests, since the sample length available is not long.

According to the results given in Table 2, both the $\lambda_{\text{max}}$ and $\lambda_{\text{max}}$ statistics suggest the presence of long-term comovements among the real stock prices. Specifically, the rank of cointegration $r$ equals one, so there are two common permanent components governing the long-term comovements of the variables. Following the Gonzalo-Granger analysis, these permanent components are estimated and reported as $f_{c}(SP)$ and $f_{c}(SP)$.

The cointegration evidence implies that long-term comovements exist among all the countries, but it does not necessarily involve all the countries. For example, the finding of a single cointegrating vector among French, German and Italian stock markets could be due to the existence of a cointegration relationship between the French and German stock markets only. Italy could be totally out of the picture. Fortunately, this can be tested formally. To check if every country actually belongs to the cointegration system, a $F$-test for exclusion restrictions on the cointegrating vector $\theta$ has been conducted. Table 2 contains the test results: every exclusion restriction is rejected by the data, confirming that France, Germany and Italy all belong to the cointegration system.

Since it may be interesting for comparison purposes to study long-term comovements of stock markets in countries outside the EMS, real MSCI stock indexes for Canada, Japan, the UK and the US are examined. These four countries, together with France, Germany and Italy, constitute the so-called G7 countries. For these four countries, the null hypothesis of no cointegration cannot be rejected at any standard level of significance $\lambda_{\text{max}} = 22.370$ and $\lambda_{\text{max}} = 13.692$ based on $k = 8$. The UK had been a member of the EMS briefly for a short time period. Excluding the data for the UK will certainly yield no statistically significant evidence of cointegration. In addition, where five stock markets in Canada, Germany, Japan, the UK and the US are considered together, as by Kasa (1993), we also fail to find significant evidence of cointegration. The difference in result between Kasa (1993) and this study may be explained by the difference in the sample period and the correction for finite sample bias in applying the cointegration test here.
Common permanent components in macroeconomic variables

The finding of long-term comovements among the EMS stock markets naturally leads to the question of what the sources of driving forces of these comovements are. Standard financial valuation models show that stock prices are influenced by fundamental factors determining the state of the economy. To identify the potential sources of stock market comovements, long-term comovements of the real money supply, real dividends and industrial production among the three EMS countries are explored. All these variables are important indicators of general economic activity. The money supply and industrial production variables are considered since relative stock market movements may reflect changes in national output and/or policy coordination across countries (Ripley, 1973). MacDonald and Taylor (1991) have presented some evidence of monetary policy convergence among the EMS members. The money supply can be related to the stock market in various ways. According to the portfolio-balance model, for instance, an increase in money supply leads to portfolio re-balancing towards other assets including securities. Changes in money supply can also affect the stock price through their effects on inflationary expectations and interest rates. Previous studies have reported international evidence showing that money growth rates can have systematic impacts on real stock returns (Mandelker and Tandon, 1983).

With respect to industrial production, this variable is a major indicator of real economic activity and it characterizes general business conditions. Chen (1991) and Fama (1981, 1990) observe that the growth rate of industrial production is a major determinant of long-horizon stock prices.
Table 2. Cointegration and permanent components in stock prices

<table>
<thead>
<tr>
<th>Testing for cointegration:</th>
<th>H0:</th>
<th>λ&lt;sub&gt;ann&lt;/sub&gt;</th>
<th>10%*</th>
<th>5%</th>
<th>λ&lt;sub&gt;ann&lt;/sub&gt;</th>
<th>10%*</th>
<th>5%</th>
</tr>
</thead>
<tbody>
<tr>
<td>r = 0</td>
<td>4.985</td>
<td>16.150</td>
<td>18.485</td>
<td>4.315</td>
<td>13.227</td>
<td>15.117</td>
<td></td>
</tr>
<tr>
<td>r = 0.5</td>
<td>30.571*</td>
<td>29.470</td>
<td>32.379</td>
<td>25.726**</td>
<td>19.618</td>
<td>22.040</td>
<td></td>
</tr>
<tr>
<td>Restriction tests on the cointegrating vector:</td>
<td>z&lt;sup&gt;2&lt;/sup&gt;-Test</td>
<td>[p-value]</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Exclude SP&lt;sub&gt;FR&lt;/sub&gt;</td>
<td>16.709</td>
<td>(0.000)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Exclude SP&lt;sub&gt;EM&lt;/sub&gt;</td>
<td>21.410</td>
<td>(0.000)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SP&lt;sub&gt;FR&lt;/sub&gt; &amp; SP&lt;sub&gt;EM&lt;/sub&gt;</td>
<td>2.898</td>
<td>(0.089)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Common permanent component estimation (equation (2)):

\[
\begin{align*}
\text{SP}_{\text{FR}} &= 0.098 - 0.041 (f_1(<SP>) + 0.139) \\
\text{SP}_{\text{EM}} &= 0.077 - 0.021 (f_2(<SP>) + 0.039) \\
\text{SP}_{\text{FR}} &= 0.068 - 0.041 (f_3(<SP>) + 0.083)
\end{align*}
\]

where

\[
\begin{align*}
 f_1(<SP>) &= -4.822SP_{\text{FR}} + 16.036SP_{\text{EM}} + 3.675SP_{\text{FR}} \\
 f_2(<SP>) &= 5.375SP_{\text{FR}} + 6.767SP_{\text{EM}} - 15.446SP_{\text{FR}} \\
 f_3(<SP>) &= 6.616SP_{\text{FR}} - 9.770SP_{\text{EM}} + 1.532SP_{\text{FR}}
\end{align*}
\]

(SP<sub>FR</sub>, SP<sub>EM</sub>, SP<sub>FR</sub> & SP<sub>EM</sub>) are the respective real stock price series for France, Germany, and Italy. The lag parameter, k, used for model estimation is selected to be 2, using the standard Schwarz information criterion. r denotes the number of the cointegrating vector. The eigenvalue, λ, is estimated to be (0.51, 0.027, 0.003). The 10% and 5% critical values for the cointegration test, as given next to the relevant test statistics, are computed based on the response surface estimates provided by Cheung and Lai (1993). An asterisk (*) indicates significance at the 10% level. A double asterisk (**) indicates significance at the 5% level. The exclusion test is a likelihood ratio test (Johansen, 1994) examining the null hypothesis that the relevant variable does not belong to the cointegration relationship.

returns, explaining more return variation than other measures of real activity such as real GNP and private investment. The consideration of the dividend variable follows from conventional financial theories. Campbell and Shiller (1987), for example, show that under the present value model, stock prices and dividends are cointegrated, i.e. they share a common permanent component.

Cointegration of the real money supply series across countries is analyzed, and the results are summarized in Table 3. The λ<sub>ann</sub> and λ<sub>ann</sub> tests for cointegration seem to yield different results. Although the λ<sub>ann</sub> test fails to find significant evidence of cointegration, the λ<sub>ann</sub> test rejects the hypothesis of no cointegration at the 5% significance level.
The difference in result may be attributed to the power property of the cointegration tests in small samples. In the analysis below, the hypothesis of one cointegrating vector for the money supply series will be maintained, a conclusion consistent with the previous finding documented by Mac- Donald and Taylor (1991). Results of exclusion restriction tests on the cointegrating vector further confirm that the three countries all enter into the cointegrating relationship. Accordingly, the implied common permanent components are estimated, as given by f<sub>1</sub>(MS) and f<sub>2</sub>(MS) in Table 3.

Table 4 and Table 5 display the results of both cointegration and common permanent component analyses for dividends and industrial production, respectively. These two cases yield qualitatively similar results. The λ<sub>ann</sub> and the λ<sub>ann</sub> tests uniformly suggest the rank of cointegration is one and, again, exclusion restriction testing supports that the cointegration system includes all three EMS countries. The findings imply that there are two common permanent components lying behind the long-run behavior of both the money supply and the industrial production series among the EMS countries. The two permanent components in dividends are labeled as f<sub>1</sub>(DI) and f<sub>2</sub>(DI) in Table 4, and those in industrial production are represented by f<sub>1</sub>(IP) and f<sub>2</sub>(IP) in Table 5.

In general, the results reported so far indicate that the money supply, dividends, and industrial production across the three EMS countries have a cointegration structure similar to that for these countries' stock prices. Specifically, these individual groups of series display long-term comovements such that they are all cointegrated with the rank equal to one. The evidence, nevertheless, has not yet established any explicit linkage between the long-term comovements among the different groups of variables.

Long-term linkages between stock prices and macroeconomic variables

The question examined next is whether the long-term comovements of stock prices can be linked to those of the
### Table 3. Cointegration and permanent components in money supply series

<table>
<thead>
<tr>
<th>Testing for cointegration:</th>
<th>λ_10%</th>
<th>5%</th>
<th>λ_{max}</th>
<th>10%</th>
<th>5%</th>
</tr>
</thead>
<tbody>
<tr>
<td>r ≤ 1 4.381</td>
<td>15.869</td>
<td>18.161</td>
<td>3.315</td>
<td>12.990</td>
<td>14.842</td>
</tr>
<tr>
<td>r = 0 26.077</td>
<td>28.959</td>
<td>31.812</td>
<td>21.693**</td>
<td>19.266</td>
<td>21.69</td>
</tr>
</tbody>
</table>

Restriction tests on the cointegrating vector:  
χ²-Test: [p-value]
Exclude MS_{Fr} 4.931 (0.025)
Exclude MS_{De} 18.744 (0.000)
Exclude MS_{It} 18.289 (0.000)

Common permanent component estimation (equation (2b)):

\[
\begin{pmatrix}
\hat{M}_{FSR}\ 
\hat{M}_{FSM} \\
\hat{M}_{FSIt}
\end{pmatrix} = \begin{pmatrix}
-0.011 & 0.042 \\
-0.030 & 0.029 \\
-0.025 & 0.031
\end{pmatrix} \begin{pmatrix}
\hat{β}_{FSR} \\
\hat{β}_{FSM} \\
\hat{β}_{FSIt}
\end{pmatrix}
\]

where

\[
\hat{β}_{FSR} = \frac{\sum_{t=1}^{T} (M_{FSR} - \bar{M}_{FSR}) (DS_{FSR} - \bar{DS}_{FSR})}{\sum_{t=1}^{T} (DS_{FSR} - \bar{DS}_{FSR})^2}
\]

(M_{FSR}, M_{FSM}, M_{FSIt}) are the real money supply series for France, Germany, and Italy, respectively. The lag parameter, k, used for model estimation is selected to be 1, using the standard Schwarz information criterion. The eigenvalue vector, λ, is estimated to be (0.128, 0.021, 0.007). An asterisk (*) indicates significance at the 10% level. A double asterisk (**) indicates significance at the 5% level. See also Table 2 for other notes.

### Table 4. Cointegration and permanent components in dividend series

<table>
<thead>
<tr>
<th>Testing for cointegration:</th>
<th>λ_10%</th>
<th>5%</th>
<th>λ_{max}</th>
<th>10%</th>
<th>5%</th>
</tr>
</thead>
<tbody>
<tr>
<td>r ≤ 1 15.536 16.150 18.485</td>
<td>9.029</td>
<td>13.227</td>
<td>15.117</td>
<td></td>
<td></td>
</tr>
<tr>
<td>r = 0 72.708** 29.470 32.379</td>
<td>57.232**</td>
<td>19.618</td>
<td>22.040</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Restriction tests on the cointegrating vector:  
χ²-Test: [p-value]
Exclude DI_{Fr} 38.467 (0.000)
Exclude DI_{De} 48.049 (0.000)
Exclude DI_{It} 29.151 (0.000)

Common permanent component estimation (equation (2b)):

\[
\begin{pmatrix}
\hat{D}_{FSR} \\
\hat{D}_{FSM} \\
\hat{D}_{FSIt}
\end{pmatrix} = \begin{pmatrix}
0.079 & -0.222 \\
0.047 & -0.031 \\
-0.010 & -0.063
\end{pmatrix} \begin{pmatrix}
\hat{β}_{FSR} \\
\hat{β}_{FSM} \\
\hat{β}_{FSIt}
\end{pmatrix} + \begin{pmatrix}
0.014 \\
0.137 \\
0.009
\end{pmatrix}
\]

where

\[
\hat{β}_{FSR} = \frac{\sum_{t=1}^{T} (D_{FSR} - \bar{D}_{FSR}) (DS_{FSR} - \bar{DS}_{FSR})}{\sum_{t=1}^{T} (DS_{FSR} - \bar{DS}_{FSR})^2}
\]

(DI_{FSR}, DI_{FSM}, DI_{FSIt}) are the corresponding real dividend series for France, Germany, and Italy. The lag parameter, k, used for model estimation is selected to be 2, using the standard Schwarz information criterion. The eigenvalue vector, λ, is estimated to be (0.305, 0.024, 0.035). An asterisk (*) indicates significance at the 10% level. A double asterisk (**) indicates significance at the 5% level. See also Table 2 for other notes.

Macroeconomic variables for these countries. To establish such linkage or the lack of it, possible relationships among the common permanent components of these various cointegration subsystems are analysed. Since the common permanent components fully characterize the long-run behaviour of cointegrated series, these permanent components...
Testing for cointegration:

\[ H_0: \lambda = 0 \]

<table>
<thead>
<tr>
<th>( r &lt; 1 )</th>
<th>( r = 0 )</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.000</td>
<td>31.14***</td>
</tr>
<tr>
<td>15.869</td>
<td>28.939</td>
</tr>
<tr>
<td>18.161</td>
<td>31.812</td>
</tr>
<tr>
<td>8.600</td>
<td>29.244***</td>
</tr>
<tr>
<td>12.990</td>
<td>19.266</td>
</tr>
<tr>
<td>14.842</td>
<td>21.639</td>
</tr>
</tbody>
</table>

Restriction tests on the cointegrating vector:

\[ \text{F-test} \quad [p\text{-value}] \]

Exclude \( IP_{48} \): 10.858 [0.000]
Exclude \( IP_{46} \): 19.495 [0.000]
Exclude \( IP_{47} \): 15.803 [0.000]

Common permanent component estimation (equation 2b):

\[
\begin{align*}
\hat{IP}_{45} &= 0.020 - 0.023 f_{IP} + 0.019 f_{IP} \\
\hat{IP}_{48} &= 0.029 - 0.025 f_{IP} - 0.008 z_{IP} \\
\hat{IP}_{46} &= 0.041 - 0.011 f_{IP} + 0.038 f_{IP}
\end{align*}
\]

where

\[ f_{IP} = -24.376 IP_{48} + 25930 IP_{48} + 17.811 IP_{48} \]

\[ f_{IP} = -33.514 IP_{48} + 0.523 IP_{48} + 16.944 IP_{48} \]

\[ f_{IP} = 16.744 IP_{48} + 28.532 IP_{48} + 12.186 IP_{48} \]

(\( IP_{48}, IP_{46}, IP_{47} \)) are the real industrial output series for France, Germany and Italy, respectively. The lag parameter, \( k \), used for model estimation is selected to be 1, using the standard Schwarz information criterion. The r-squared value, \( \rho \), is estimated to be 0.0169, 0.0153, 0.0102). An asterisk (*) indicates significance at the 10% level. A double asterisk (**) indicates significance at the 5% level. For other notes, see Table 2.

(two of them exist for each variable group) are useful candidates for studying the long-run relationship of one set of variables with other sets of variables. In examining cointegration between the common permanent components in stock prices and the common permanent components in the macroeconomic variables, the two common permanent components in stock prices are considered separately. The reason is that there can be different underlying economic forces governing these two common permanent components. As a result, additional information may be gained by studying each common permanent component of stock prices individually.

Table 6a contains the results of cointegration analysis between the first common permanent component in stock prices, \( f_{IP} \), and the six permanent components corresponding to those of the money supply, dividends and industrial production. The results from the \( \hat{\lambda}_{n} \) and \( \hat{\lambda}_{n} \) tests suggest that the rank of cointegration is equal to two. Since finding cointegration in a multivariate system as a whole can obscure the fact that some variable may not actually belong to any cointegration relationship with the others, formal exclusion restriction tests are performed. In our case, for example, it is possible that cointegration may exist among the money supply, dividends and industrial production only, without including stock prices. The results of the restriction tests are reported in Table 6a as well; they confirm that the common permanent component in stock prices does indeed enter into a cointegration relationship with those in the macroeconomic variables. In addition, every macroeconomic variable under study contributes to the cointegration relationship.

Table 6b gives the results of cointegration analysis between the second common permanent component in stock prices, \( f_{IP} \), and all the six \( \alpha \) macroeconomic variables. According to both the \( \hat{\lambda}_{n} \) and \( \hat{\lambda}_{n} \) tests, the rank of cointegration is equal to one, in contrast to the results for the first common permanent component, \( f_{IP} \). The cointegration test results thus suggest the presence of one cointegration relationship among the variables. Further exclusion restriction tests reveal, however, that the stock price variable does not belong to the cointegration relationship. Hence, while the first common permanent component in stock prices is found to be related to the common permanent components in the money supply, dividends and industrial production, the second common permanent component in stock prices is not found or so be so.

An interpretation of the above findings is that the long-term movements of the money supply, dividends and industrial production among the three EMS countries may all contribute to the long-term cointegration of these countries' stock prices. However, the relative movements of the stock markets in the long run cannot be fully explained by the relative movements of the set of macroeconomic variables considered.
Table 6. Long-term linkages between stock prices and macroeconomic variables

<table>
<thead>
<tr>
<th>Testing for cointegration:</th>
<th>5%</th>
<th>5%</th>
<th>5%</th>
<th>5%</th>
<th>5%</th>
<th>5%</th>
</tr>
</thead>
<tbody>
<tr>
<td>$H_0: \alpha = 0$</td>
<td>85.442</td>
<td>72.314</td>
<td>76.796</td>
<td>25.370</td>
<td>35.341</td>
<td>36.303</td>
</tr>
<tr>
<td>$r \leq 2$</td>
<td>99.244*</td>
<td>98.317</td>
<td>103.534</td>
<td>38.802*</td>
<td>38.796</td>
<td>42.957</td>
</tr>
<tr>
<td>$r = 1$</td>
<td>1.54</td>
<td>129.421</td>
<td>135.162</td>
<td>54.900**</td>
<td>45.757</td>
<td>48.934</td>
</tr>
</tbody>
</table>

Restriction tests on the cointegrating vector:


(b) For the second common permanent component in stock prices, $F_0^{(2)}(SP)$

<table>
<thead>
<tr>
<th>Testing for cointegration:</th>
<th>10%</th>
<th>5%</th>
<th>5%</th>
<th>5%</th>
<th>5%</th>
<th>5%</th>
</tr>
</thead>
<tbody>
<tr>
<td>$H_0: \alpha = 0$</td>
<td>20.345</td>
<td>72.315</td>
<td>76.796</td>
<td>25.370</td>
<td>35.341</td>
<td>36.303</td>
</tr>
<tr>
<td>$r \leq 2$</td>
<td>93.723</td>
<td>98.317</td>
<td>103.534</td>
<td>38.796</td>
<td>42.957</td>
<td></td>
</tr>
<tr>
<td>$r = 1$</td>
<td>1.54</td>
<td>129.421</td>
<td>135.162</td>
<td>54.900**</td>
<td>45.757</td>
<td>48.934</td>
</tr>
<tr>
<td>$r = 0$</td>
<td>150.450**</td>
<td>25.421</td>
<td>135.162</td>
<td>56.714**</td>
<td>45.757</td>
<td>48.934</td>
</tr>
</tbody>
</table>

Restriction tests on the cointegrating vector:

| $\gamma^2$-Test [p-value] | 1.331 | 8.130 | 2.470 | 2.954 | 2.941 | 2.649 |

The lag parameter, $k$, used for model estimation is selected to be 2 in both (a) and (b), using the standard Schwarz information criterion.

The eigenvalue vector, $\lambda$, is estimated to be $0.295, 0.219, 0.150, 0.096, 0.060, 0.029, 0.008$ in (a) and $0.303, 0.212, 0.127, 0.105, 0.063, 0.039, 0.010$ in (b). An asterisk (*) indicates significance at the 10% level. A double asterisk (**) indicates significance at the 5% level. See also Table 2 for other notes.

V. FURTHER SUBPERIOD ANALYSIS

Studies by Giavazzi and Giovannini (1988, 1989) and Weber (1991), among others, have suggested that the economic and financial linkages among EMS countries are stronger and more evident in the post-1987 period than the pre-1987 period. The relatively frequent and large size of exchange rate realignments in the pre-1987 period reflects the lack of credible macroeconomic policy coordination over this time period. For the post-1987 period, on the other hand, strengthening policy coordination among EMS countries can be observed, as notably signified by the adoption of the September 1987 Basle-Nyborg agreement. Accordingly, the post-1987 period may generate stronger cointegration results than the pre-1987 period.

The empirical analysis is repeated for two subperiods: 1979–86 and 1987–92. The results of the subperiod analysis are summarized in Table 7. For the 1979–86 period, no significant evidence of long-term cointegration between stock prices and economic fundamentals can be found. For the 1987–92 period, however, the hypothesis of no cointegration between stock prices and economic fundamentals can be rejected at the 10% level. The results of exclusion tests strongly confirm that the common permanent component in stock prices enters into a cointegration relationship with those in the macroeconomic variables. Hence, in contrast to the pre-1987 period, economic fundamentals play a significant role in contributing to the long-term movements of stock markets among major EMS countries over the post-1987 period.

To further check the robustness of our results for the post-1987 period, two additional issues are examined: (1) the potential effects of the international stock market crash of October 1987 and (2) the sensitivity of the results to the
### Table 7: Results of subperiod analysis

<table>
<thead>
<tr>
<th>Subperiod</th>
<th>f₁(SP)</th>
<th>f₂(SP)</th>
<th>f₃(SP)</th>
<th>f₄(SP)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1979-86 period</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. For the 1st common permanent component in stock prices, f₁(SP)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$r &lt; 1$</td>
<td>91.023</td>
<td>105.009</td>
<td>110.646</td>
<td>34.087</td>
</tr>
<tr>
<td>$r - 0$</td>
<td>133.595</td>
<td>138.230</td>
<td>144.458</td>
<td>24.272</td>
</tr>
<tr>
<td>Exclude f₁(SP)</td>
<td>1.008</td>
<td>0.313</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. 1987-92 period</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.1 For the 1st common permanent component in stock prices, f₁(SP)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$r &lt; 1$</td>
<td>82.936</td>
<td>105.009</td>
<td>110.654</td>
<td>34.456</td>
</tr>
<tr>
<td>$r - 0$</td>
<td>129.716</td>
<td>138.230</td>
<td>144.458</td>
<td>46.160</td>
</tr>
<tr>
<td>Exclude f₁(SP)</td>
<td>2.255</td>
<td>0.133</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The model parameter k, used for model estimation, is selected to be 2 in all the cases, using the standard Schwarz information criterion. An asterisk (*) indicates significance at the 10% level. A double asterisk (**) indicates significance at the 5% level. See also Table 2 for other notes.

The choice of the base country (all the variables for each country have been expressed in real US dollars in the above analysis). The first issue is addressed by conducting cointegration analysis with the inclusion of a dummy variable to control for the possible impact of the October 1987 crash. The second issue is addressed by evaluating results obtained from using Germany, France and Italy as the base country, respectively.

Panel 1 of Table 8 gives the results when the October 1987 crash dummy variable is added to the cointegration analysis. Although the cointegration results are somewhat weaker than in the case of no dummy variable, especially for one of the common permanent component of stock prices, the results in general support that the comovements in stock prices are at least partly linked to those comovements in macroeconomic variables. Panels 2 to 4 of Table 8 report the results of cointegration analysis when Germany, France and Italy are used in turn as the base country, not the US. The results show that our findings are not sensitive to the choice of base country.

Finally, although the analysis has so far focused on dynamic relationships among large EMS countries, it may be interesting to consider some smaller countries, like the Benelux countries, in the analysis. Stock index data for Belgium and the Netherlands are available from our MSCI data set. The following question is posed: Can the influence of the macroeconomic fundamentals of large EMS countries be so strong that they govern the stock market movements of smaller countries, like Belgium and the Netherlands? The foregoing subperiod analysis is repeated to include the stock price series for these two countries. In general, the results indicate no significant evidence of cointegration ($r_{max} = 134.173$ and $r_{max} = 5.299$ for Belgium and $r_{max} = 134.760$ and $r_{max} = 47.927$ for the Netherlands) at any standard levels of significance. Of course, the statistical failure to find long-term comovements does not absolutely show the complete absence of such comovements. Moreover, the results in no way preclude the presence of other forms of interactions between large and small EMS countries, on which future research is certainly warranted.
## Long-term stock market comovements in EMS countries

### Table 8. Further analysis of the 1987-92 period

<table>
<thead>
<tr>
<th>1. Including a dummy variable for the October 1987 crash</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) For the 1st common permanent component in stock prices, $f_1(SP)$</td>
</tr>
<tr>
<td>$r &lt; 1$</td>
</tr>
<tr>
<td>$r = 0$</td>
</tr>
<tr>
<td>$z^2$-Test</td>
</tr>
<tr>
<td>[p-value]</td>
</tr>
<tr>
<td>Exclude $f_2(SP)$</td>
</tr>
<tr>
<td>$r &lt; 1$</td>
</tr>
<tr>
<td>$r = 0$</td>
</tr>
<tr>
<td>$z^2$-Test</td>
</tr>
<tr>
<td>[p-value]</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>2. Using Germany as the base country</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) For the 1st common permanent component in stock prices, $f_1(SP)$</td>
</tr>
<tr>
<td>$r &lt; 1$</td>
</tr>
<tr>
<td>$r = 0$</td>
</tr>
<tr>
<td>$z^2$-Test</td>
</tr>
<tr>
<td>[p-value]</td>
</tr>
<tr>
<td>Exclude $f_2(SP)$</td>
</tr>
<tr>
<td>$r &lt; 1$</td>
</tr>
<tr>
<td>$r = 0$</td>
</tr>
<tr>
<td>$z^2$-Test</td>
</tr>
<tr>
<td>[p-value]</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>3. Using France as the base country</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) For the 1st common permanent component in stock prices, $f_1(SP)$</td>
</tr>
<tr>
<td>$r &lt; 1$</td>
</tr>
<tr>
<td>$r = 0$</td>
</tr>
<tr>
<td>$z^2$-Test</td>
</tr>
<tr>
<td>[p-value]</td>
</tr>
<tr>
<td>Exclude $f_2(SP)$</td>
</tr>
<tr>
<td>$r &lt; 1$</td>
</tr>
<tr>
<td>$r = 0$</td>
</tr>
<tr>
<td>$z^2$-Test</td>
</tr>
<tr>
<td>[p-value]</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>4. Using Italy as the base country</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) For the 1st common permanent component in stock prices, $f_1(SP)$</td>
</tr>
<tr>
<td>$r &lt; 1$</td>
</tr>
<tr>
<td>$r = 0$</td>
</tr>
<tr>
<td>$z^2$-Test</td>
</tr>
<tr>
<td>[p-value]</td>
</tr>
<tr>
<td>Exclude $f_2(SP)$</td>
</tr>
<tr>
<td>$r &lt; 1$</td>
</tr>
<tr>
<td>$r = 0$</td>
</tr>
<tr>
<td>$z^2$-Test</td>
</tr>
<tr>
<td>[p-value]</td>
</tr>
</tbody>
</table>

Statistical significance is indicated by an asterisk (*) for the 10% level or a double asterisk (**) for the 5% level. The lag parameter, k, used for model estimation is selected to be 2 in all the cases, using the standard Schwarz information criterion. See also Table 2 for other notes.
VI CONCLUDING REMARKS

The advent of the EMS since Misch 1979 has revived and
notably expanded the literature on international mone-
tary systems. The experience of the EMS is interesting to
study, and it has impacts on policy and economic
analyses. This study explores the issue concerning the po-
tential existence of long-term comovements of national
stock markets in light of the experience of the EMS. Al-
though long-term comovements of national stock markets
have been investigated in previous empirical work, little has
been done to study those of EMS stock markets and also
investigate the possible sources of their comovements. Why
can national stock markets exhibit long-term comove-
ments? Are such long-term market comovements rational?
To what extent do they reflect similar long-term co-move-
ments in economic fundamentals? All these questions point
to the need to analyse and identify the possible sources of
long-term market comovements.

In this study the long-term comovements of stock mar-
kets in three EMS countries – France, Germany and Italy
– have been examined based on monthly data for the period
1979-1992. Empirical results support that the stock markets
in these countries display long-term comovements. The re-

Sults also suggest the presence of two common permanent
components driving the long-run dynamics of these stock
markets. To identify two interpretable sources that can
explain the long-term stock market comovements among
these EMS countries, this study further explores whether
the common permanent components found in stock prices

be linked to the relative dynamics of macroeconomic vari-
bles among the EMS countries. The macroeconomic vari-
ables under study include the money supply, dividends and
industrial production. Interestingly, empirical evidence sug-
gests that, like the stock price variable, there are two com-
mon permanent components governing the long-term
comovements among the EMS countries in each of these
macroeconomic variables. To investigate the possible link-
age between the long-term comovements of these variables
and those of stock prices, cointegration among the common
permanent components in stock prices and the macroeco-
nomic variables is analysed. It is found that although part of
the long-term comovements of stock prices can be
attributed to those comovements of several macroeconomic
variables (especially for the post-1987 period), the explana-
tory power of the latter is far from strong. Nonetheless, the
results confirm at least a limited role of these macroeco-
nomic variables in accounting for the relative stock market
comovements among the three EMS countries. It should be
emphasized that the findings here apply to relative move-
ments of different stock markets, not movements of indi-

vidual stock markets, which prior studies have primarily
examined.

On the missing or weak link between the comovements of
EMS stock markets and those of economic fundamentals
be explained in terms of market psychology? Possibly be-
cause of their geographical proximity or the potential mon-
etary link implied by the EMS exchange rate mechanism,
investors may simply follow price movements in different
major EMS stock markets. Such behaviour, which is moti-

vated by non-fundamentals, can arguably be 'rational' as
long as most investors behave in the similar manner. How-
ever, even though the market psychology approach may be
interesting in explaining short-term market comovements,
its ability to explain long-term market comovements appears
questionable unless the market psychology can eventually be
supported by similar movements in economic fundamentals.

Another interpretation of the results of this study is the
missing-variables perspective. The variables examined here
are important macroeconomic indicators, but they by no
means exhaustively characterize the macroeconomy. To
the extent that stock prices can be influenced by a wide variety
of economic factors, it is possible that some other variables
not considered in this study may also contribute to the
long-term comovements of stock prices. Future research to
identify the relevant omitted variables should be of interest
for a better understanding of the dynamic behaviour of
stock markets. The present study can be viewed as a prelimi-
nary step in exploring the rational basis of long-term stock
market comovements.

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